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ABSTRACT

A review of the literature indicates that, in the 1990s, production workers will need significant amounts of human capital investments in terms of education, training, and retraining, to have the new and updated computer and technical skills required by American employers. The present empirical study determines and defines seven factors that are involved in the process of integrating computer technology into the K-12 public school curriculum and presents these factors in the form of a causal model: (1) Upper Management Encouragement; (2) Teachers' Training and Background; (3) Technology Integration Plan; (4) Teachers' Overall Attitude toward Computers; (5) Teachers' Attitudes toward Limited Use of Computers; (6) Use of Technology on the Job; and (7) Use of Technology at Home. Twenty-one hypotheses based on this model are proposed and tested using Linear Structural Relations analyses. The study was executed in a West Texas school district, where all administrators and teachers were asked to complete survey questionnaires. Of the 270 questionnaires distributed, 168 were returned (61%). The survey was followed by 12 personal staff interviews. The results support the fact that technology integration into the K-12 curriculum is a complex matter and must be addressed through a number of variables, including training for teachers, adequate public and/or private funding for the acquisition of equipment, and the formation and implementation of a technology integration plan supported by upper management. A copy of the survey instrument and supporting data from the study are appended. (47 references) (BBM)

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EVALUATING A TECHNOLOGY INTEGRATION CAUSAL MODEL FOR THE K-12 PUBLIC SCHOOL CURRICULUM: A LISREL ANALYSIS

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EVALUATING A TECHNOLOGY INTEGRATION CAUSAL MODEL FOR THE K-12 PUBLIC SCHOOL CURRICULUM: A LISREL ANALYSIS

Abstract

In the 1990's, production workers will need significant amounts of human capital investments in terms of education, training, and retraining, to have the new and updated skills required by American employers. The report by the National Commission of Excellence in Education also focused on the accelerating demand for highly skilled workers in new fields. It is evident that public education must prepare youth for this computer and technical environment. Unfortunately, the education of the workforce is not keeping up with this changing technology in the work environment. The present empirical study determines and defines the factors that are involved in the process of integrating computer technology into the K-12 public school curriculum. It attempts to answer the "how" and "why" questions in order to understand the nature and complexity of this integration. When a district administration considers and applies the findings of this study of the seven factors that discourage and/or encourage computer technology integration into the school district's curriculum, and the priority relationships among them, schools will become more efficient and effective in preparing the future work force.

EVALUATING A TECHNOLOGY INTEGRATION CAUSAL MODEL FOR THE K-12 PUBLIC SCHOOL CURRICULUM: A LISREL ANALYSIS

Introduction

In the 1990's, "Production workers will need significant amounts of human capital investments in terms of education, training, and retraining, to have the new and updated skills required by American employers" (Subcommittee on Oversight and Investigations of Energy and Commerce, 1985, p. 7). The Subcommittee stated that unless our labor force is properly trained for this automated microelectronic environment, "millions of American workers may continue to feel like square pegs in the world of round holes" (Subcommittee on Oversight and Investigations of Energy and Commerce, 1985, p. 13).

Another report (National Commission on Excellence in Education, 1983) focused on the accelerating demand for highly skilled workers in new fields and expressed concerns about an inadequately educated workforce (Simnacher, 1990). Corporate leaders are also emphasizing the need for more intense efforts to prepare youth for the technical jobs of the future (Kazi-Ferrouillet, 1989).

It is evident that public education must prepare youth for this technical environment where the economic resources are knowledge, information, and individual innovators (Sculley, 1989; Kearns, 1988). Even though more and more schools are being mandated by states to integrate information technology into their curricula (Texas Education Agency, 1988), some feel that this mandate is not being implemented.

Previous research studies investigating the integration of computer technology in public schools are not very effective. The present empirical study describes and assesses the situation as it presently exists within a Texas public school environment. It determines and defines the factors that are involved in

the process of integrating computer technology into the K-12 public school curriculum. The goal is to add empirical evidence to the existing literature so that the education community may become more effective in preparing the future work force for the microelectronic world of work.

The remainder of the manuscript is organized as follows. The next section discusses the literature in the area. This is followed by a presentation of a technology integration causal model for the K-12 public school curriculum and the related hypotheses. The subsequent sections present and discuss the research method, the reliability and validity of the instrument used for the present research study, and the research findings. The paper concludes by emphasizing the importance of integrating technology in the K-12 curriculum.

Literature Review

A 1983 survey revealed that of the 15,275 public school districts in the United States, 86% used computers and 68% owned computers (Burgess, Davidson, and Ginter, 1987). These percentanges, however, do not indicate the extent of actual usage. According to McGee (1987), most students use the machine less than thirty minutes per week and it is rarely used in elementary schools as a tool or resource to help decision making, problem solving, teaching of programming or word processing.

A number of researchers investigated factors (such as socio-economic status, cost, upper management support, teacher training, and attitude towards computer) that determine the success or failure of computer technology integration in the curriculum. McGee (1987) found that the process of implementation was successful when the social context of the school was understood. Kirby, Oescher, Wilson, and Smith-Gratto (1990) also found that the student's access to computers is directly related to the student's ability

classification and socioeconomic status and concluded that students attending schools in less affluent areas and not classified as special-needs students appear to be technologically at-risk.

Cost is also a factor of computer technology integration. Some argue that the public school computer revolution had been "derailed" because of high cost and inadequate training of teachers (Educators Question Computer Revolution, 1988, p. 94). Since computer usage in public education averages one machine per 30 students (Power On! New Tools for Teaching and Learning, 1988), the financial commitment is huge.

Beaver (1987) showed that computer technology programs do not have continued financial support. In 70% of the schools he investigated, computer expenses were not permanent line items. Also, computer training and maintenance was the least proportion of the computer budget.

Feuer (1989) rightly pointed out that the traditional cost-effectiveness analyses of computer-based education did not account explicitly for the multiple objectives of education and the long-term gains.

Another factor regarding computer technology integration seemed to be the lack of upper management (from the Federal government to the local site manager) support. Upper management must understand the process of integrating computers into the curriculum in schools (Foshay, 1988). D'Amico (1990) clearly demonstrated the need for strong district and school administrator leadership support.

Madsen & Sabastiani (1987) found high correlation between significant improvement in knowledge of and attitude toward computers among high school teachers and increased teacher training. From its discussions and surveys among members, the Texas Computer Education Association (an organization with 3000

members) observed a clear pattern of the need for teacher training (Dawson, 1986-87). The Office of Technology Assessment also concluded that teachers need both training and education if technology is to take hold in schools (Turner, 1989).

Research studies also indicate that a teacher's attitude toward computers and the implementation of computer instruction are inseparable. Schumacker and Hossain (1990), for example, suggested that the teachers' usage and perceptions of a computer learning center are important in reaching the goal of utilizing computer-based instructional technology. Hannaford (1988) tested attitudes of pre-service teachers and in-service teachers toward scheduling and use of computers. The conclusion was that teachers consider the computer to be a simple, flexible and accessible tool. The Reed study (1986) looked at teacher attitudes toward educational computing. The predominate attitude conveyed was that computers are an integral part of instruction and that computer instruction should not be restricted to the very bright students and to the math curriculum.

None of the aforementioned studies, however, have investigated causal relationships between the factors that influence computer technology integration into a school district's curriculum. The present study will not only identify these relationships in the form of a causal model but also test the model using Linear Structural Relations (LISREL) analyses. The next section discusses the causal model.

A Causal Model for Integrating Information Technology into the Curriculum and Related Hypotheses

Based on the aforementioned literature review, it is hypothesized that Upper Management Encouragement (UME), Teachers' Training and Background (T&B), Technology Integration Plan (TIP), Teachers' Overall Attitude Toward Computers

(OAC), Teacher Attitudes Toward Limited Use of Computers (ATL), Use of Technology on the Job (UTJ), and Use of Technology at Home (UTH) are related in a manner that is consistent with the causal model shown in Figure 1. Hypotheses for primary research variables and rationales for their inclusion in the study are provided below.

Place Figure 1 About Here

H1: Upper management encouragement fosters teacher training and background.

D'Amico (1990) suggested that strong leadership of school administrators is important for the entire integration process. Trainor (1987) demonstrated the need for upper management support for teacher's training.

H2: Upper management involvement is likely to lead to the formulation of a technology integration plan.

Knupfer (1988) had indicated that the lack of program direction was a problem. Martin (1988) demonstrated the importance of centralized planning and decentralized decision making for computer integration in the curriculum.

H3: Upper management encouragement positively affects teacher overall attitudes toward technology integration in the curriculum.

McGee (1986) indicated that a priority job for management is to convince teachers to adopt a positive attitude toward computer instruction. The Trainor (1987) study implied that upper management affects teachers' attitudes by providing resources for training and capital equipment and by eliminating "red tapes".

H4: Upper management encouragement positively affects teacher attitude toward limited use of computer technology.

School districts have used federal funding (often directed toward a select group of students such as gifted, learning disabilities or vocational education)

to equip their schools with hardware & software. This specific funding encouragement continually affects teachers' attitudes toward limited or specific use.

H5: Upper management encouragement of teachers affects their use of technology on the job.

By rewarding and recognizing teachers, upper management can promote computer use (McGee 1986). More specifically, upper management encouragement in the form of improved lab scheduling, improved teacher training, employing computer specialists, and establishing goals and objectives can improve computer use (Reed, 1986).

H6: Upper management encouragement positively supports teacher use of technology at home.

McCarthy (1988) suggested that management can encourage teachers' use of computers at home by allowing them to take a computer home.

H7: Teacher training and background positively affects technology integration plan for integrating computers in the curriculum.

Research confirms that teachers' preconceptions, including training and background, are crucial to the process of computer technology plans in schools (Knupfer, 1988; Martin, 1988).

H8: Teacher training and background positively affects overall attitude toward integrating computers in the curriculum.

The literature is replete with studies that document a positive relationship between one's training and background and one's attitude towards the use of computers (Knupfer, 1988; Madsen & Sabastiani, 1987; Trainor, 1987).

H9: Teacher training and background affects limited use of computer technology.

Computers should be used only for math and computer science students or be used only for the brightest students are reflective of limited teachers' training in technology (Honeyman and White, 1987).

H10: Teachers' training and background positively support their use of technology on the job.

Fifty five percent of teachers surveyed by Trainor (1987) stated that lack of training was a major hurdle for effective use of computers in their class rooms. If technology is to take hold in schools, teachers must be trained and educated (Turner, 1989).

H11: Teacher training and background positively influences use of technology at home.

Exposure to experience with computers reduces anxiety (Honeyman and White, 1987) which suggests a more willingness to use the tool both at work and at home. Martin stated that the best way to create change in the classroom is to teach teachers how to use computers for their personal use (Martin, 1988).

H12: Technology plan for integrating computers into the curriculum positively affects teacher overall attitude towards such integration.

A well-crafted information systems (technology) plan should have arrangements for user involvement (Mushet 1985). User involvement will require user training and training means better overall user attitudes (as suggested and supported in H8).

H13: Technology integration plan positively affects teacher attitude toward limited use of computers.

D'Amico (1990) strongly encouraged instruction, planning, and decision making as group activities of not just teachers but entire staffs.

Long-range technology plans resulted in positive attitudes (in those who were involved) toward computers use (Martin, 1988).

H14: Technology plan for integrating computers into the curriculum positively influences use of such technology on the job.

It is well-recognized in information systems (IS) literature that the successful implementation of an IS project requires careful project planning (Alter and Ginzberg 1978, Davis and Olson 1985, Dickson and Wetherbe 1985, Mushet 1985). We believe this line of reasoning equally applies to computer integration technology plan (which is an IS plan) and the use of such technology on the job (which, in essence, is an IS project) for teaching students.

H15: Technology plan for integrating computers into the curriculum positively affects teacher use of such technology at home.

Based on the same line of reasoning provided for hypothesis H14, we argue that there is a causal relationship between a technology plan for integrating computers in the curriculum and the use of such computers at home. In fact, the Martin study also suggests this (Martin, 1988, p. 224).

H16: Overall teacher attitude affects the attitude towards limited use of computers.

Intuitively, teachers' overall attitude should affect their limited attitude since the limited attitude is a part of the whole (the overall attitude). The D'Amico study (1990) showed that teachers did not adopt computer technology into instruction because their attitudes towards computers were somewhat resistant.

H17: Teacher overall attitude toward technology integration in the curriculum affects the use of technology on the job.

McGee (1986) empirically showed a positive relationship between teacher attitude and implementation. Reed (1986) suggested that if teachers do not value computers as an instructional device, they will not use computers even if they are available for instructional purposes.

H18: Teacher' overall attitude towards technology integration in the curriculum affects the use of such technology at home.

Those teachers who are positively impressed with computers are also likely to use computers, if available, at home. Research studies cited for the aforementioned hypothesis can, therefore, be used to support this hypothesis.

H19: Teacher attitude toward limited use of computers affects their use of such technology on the job.

Dawson (1986-87) observed that, due to negative experiences with computer technology, the classroom teacher may label himself or herself as "just not a computer-type person" and becoming an outspoken opponent against the use of such technology in the classroom (p. 63).

H20: Teacher attitude toward limited use of computers affects the use of such technology at home.

Because teachers have often perceived that computers are for limited use such as special education (Fick, Fitzgerald, and Milich, 1984), for practice (Robinson, 1985; Standiford, Jaycox, and Auten, 1983), for math and science, they viewed computers as unhelpful or unrelated technology in the home.

H21: Teacher use of computers on the job positively affects the use of such technology at home.

If a teacher has a computer at home and uses it, he or she is likely to be inclined to use it at work. McCarthy (1988) suggested loaning or giving computers to teachers. This will cause teachers to be more proficient computer users.

Methodology

Subjects

The research study was executed in the natural setting of a West Texas school district. During the last week of October 1990, all administrators and

teachers were asked to participate in this research study. Two hundred and seventy questionnaires (accompanied by a letter from the Director of Curriculum and Instruction of the School District) were distributed. One-hundred and sixty-eight responses were returned (three administrators did not participate). Four surveys were not used because of improper coding. The return response was 61% (168/270). This return rate is high and acceptable by any standard. The written survey was followed by twelve personal, staff interviews.

Instrument

A 24-item instrument (the instrument is available from the authors) was used to measure variables such as Upper Management Encouragement (UME), Training and Background (T&B), Overall Attitudes Toward Computers (OAC), Technology Integration Plan (TIP), Attitude Towards Limited Use (ATL), Use of Technology on the Job (UTJ), and Use of Technology at Home (UTH).

Depending on the nature of the question, the participants in the study responded via either: (a) 4-interval Likert-type scale (strongly agree=A, agree=B, disagree=C, or strongly disagree=D), or (b) bi-polar scale (yes or no). There was also an opportunity for personal input on the survey.

Reliability of the Instrument

The reliability of the instrument was tested through the use of Cronbach's alpha reliability coefficient (Cronbach and Meehl 1955). Descriptive statistics and Cronbach's alpha reliability coefficients for different variables are provided in Table 1. These coefficients are within the acceptable norm as suggested by Brown (1976) and, therefore, the instrument deserved further validity investigations.

Place Table 1 About Here

Validity of the Instrument

Factor Analysis (with varimax rotation) was used to test for the validity of the instrument. Factor Analysis is considered one of the most powerful methods for validating instruments (Kerlinger 1973). All items loaded on or at greater than 40 percent on different factors indicating the instrument's validation (see Table 2).

Place Table 2 About Here

Results

In order to test for causal relationships among the variables, the Linear Structural Relations (LISREL) model was used. This model, introduced by Joreskog (1973), is an ambidextrous approach to structural equation models that "have intertwined the best of psychometric, econometric, and statistical theory" (Bentler, 1978, p. 268). "They are not only more powerful than path analysis but also based on less restrictive assumptions and subsume path analysis and other approaches as special cases" (Pedhazur 1982, p. 637).

Columns 1 and 2 show the Pearsonian correlation and the respective significance level for each path. Column 3 of Table 3 states the path between different variables. Columns 4 and 5 show the gamma and beta coefficient variables and their values respectively. The last two columns indicate whether these values are meaningful (a coefficient value is meaningful when its sign agrees with the direction of the hypothesis it is representing) and greater than .05 (Billings and Wroten (1978) and Kerlinger and Pedhazur (1973) urged for deletion of those paths whose value fell below the .05 level).

Place Table 3 About Here

Following these guidelines, the paths from T&B to ATL, TIP to UTH, and OAC to UTH were deleted because they were not meaningful (i.e., their actual direction was opposite the hypothesized direction). Similarly, the paths from UME to UTH, TIP to UTJ, ATL to UTJ, and ATL to UTH were also deleted because they were not statistically significant (i.e. their beta or gamma coefficient value fell below the .05 level). The paths UME to ATL and OAC to UTJ were also deleted because they were neither statistically significant or meaningful.

This procedure for path elimination is called "theory trimming" (Heise 1969). The objective here is to identify the trimmed model that most adequately portrays the hypothesized relationships among the variables. Before a definite conclusion can be reached, however, the gamma and beta coefficient value for the remaining paths must be recalculated and their meaningfulness and significance level must be checked (Griffin 1977). Table 4 shows the recalculated value of gamma and beta coefficients for the remaining paths in the technology integration model. All gamma and beta coefficients value are statistically significant. The final trimmed model is shown in Figure 2.

Place Table 4 and Figure 2 Here

Testing the Trimmed Technology Integration Model

The validity of a trimmed causal model is dependent on how closely it can approximate the original causal model (Kerlinger and Pedhazur 1973). Once this validation is established, one can then safely assume that the trimmed model fits the data (Billings and Wroten 1978). Table 5 shows different paths in the trimmed model and their original correlation, reproduced correlation, residual, and normalized residuals. The last column of the table indicates whether normalized residuals are greater than 2.00. This is important because Pedhazur

(1982, p. 669) suggested that "in order for the causal model to be effective, the normalized residuals should be less than 2." All but one residual in the causal model satisfy this criterion. This suggests that the trimmed technology integration model is reasonably consistent with the data collected for the study.

Place Table 5 About Here

Discussion

The results of the present research study support the trimmed version of the technology integration model. It is also possible that other versions of the model will fit the data. If one, however, considers the fact that the present version is grounded in theory (i.e., derived from the technology integration literature), its case is considerably strengthened.

The majority of the paths, hypothesized in the technology integration model, were supported. There are, however, some differences between what was hypothesized and what was supported. These differences are discussed below.

Effects of Upper Management Encouragement on T&B, TIP, OAC, ATL, UTJ, and UTH

The results of the present study indicate that (see the trimmed model) Upper Management Encouragement (UME), as hypothesized, has significant positive impact on Teacher Training and Background (T&B), Overall Attitude Towards Computers (OAC), Use of Technology on the Job (UTJ), and the Technology Integration Plan (TIP) itself. This means that the results of this study agree with the literature used to support hypotheses 1, 2, 3, and 5. The literature in the area has shown consistent positive relationships between Upper Management Encouragement and (a) Teachers' Training and Background (D'Amico, 1990; McCarthy, 1988; Trainor, 1987), (b) Overall Attitude Towards Computers (McCarthy, 1988; McGee, 1986; Trainor, 1987), (c) Use of Technology on the Job (McGee, 1986; Reed,

1986), and (d) the formation of a Technology Integration Plan (Knupfer, 1988; Martin, 1988).

Hypotheses 4 and 6 were not supported by the present study. This suggests that upper management encouragement may not have any impact on teachers' use of computers at home or their attitude towards limited use of computers. This result can be explained by the fact that only 60 percent of the teachers in this study felt comfortable using computers for personal use and a much lower percentage (30 percent) of the teachers had computers in their homes.

Effects of Training and Background on TIP, OAC, ATL, UTJ, and UTH

The results of the study indicate that Teachers' Training and Background (T&B) positively affect Technology Integration Plan (TIP), Overall Attitude Towards Computers (OTC), Use of Technology at Job (UTJ), and Use of Technology at Home (UTH). This means hypotheses 7, 8, 10, and 11 were supported. The literature shows a positive relationship between Teachers' Training and Background and (a) Technology Integration Plan (Knupfer, 1988; Martin, 1988), (b) Overall Attitude Towards Computers (Knupfer, 1988; Madsen and Sabastiani, 1987; and Mahmood and Medewitz 1989), (c) Use of Technology on the Job (Trainor, 1987; Turner, 1990), and (d) Use of Technology at Home (Hunter & Aiken, 1984; Honeyman and White, 1987; Martin, 1988; Kerr, 1990; McCarthy, 1988).

It is not quite known why teachers' training and background was not enough to change their attitude towards limited use of technology (H9). It is perhaps because subjects' attitude towards computers does not change as they become more and more computer literate (Mahmood and Medewitz 1989). Or this could be due to limited training (in which a computer class or two is taught) which leaves teachers with high anxiety state. As a result, they do not feel comfortable about using computers at work (Honeyman and White, 1987).

Impacts of Technology Integration Plan on OAC, ATL, UTJ, and UTH

The trimmed technology integration model clearly demonstrated the positive impact of Technology Integration Plan (TIP) on teacher Overall Attitude towards computers (OAC) and Attitude Towards Limited Use of Computers (ATL). In spite of the positive nature of these relationships, only 17 percent of the teachers in this study were included in the Technology Integration Plan.

The present study did not show any relationships between Technology Integration Plan (TIP) and Use of Technology at Job (UTJ) or at Home (UTH). This is not surprising at all given the fact that 70 percent of teachers surveyed for this study indicated that they would like to have more access to computers at school for instructional and record keeping needs and, more importantly, 83 percent did not even know that a technology integration plan existed.

Effects of Overall Attitude Towards Computers on ATL, UTJ, and UTH

It is interesting to note that Teacher Overall Attitude Towards Computers (OAC) did not affect the Use of Technology at Work (UTJ) or at Home (UTH). Even though there is a strong desire to use computers, a feeling that every child should be exposed to information technology and that this technology should be integrated into the curriculum, this attitude did not affect teachers' use of technology at work or at home. The reason is simple: most of the teachers did not have access to computers at work or at home. Only 30 percent of the teachers surveyed for this study have computers in their homes, only 29 percent of them use computers with their students and only a little over half of those surveyed feel comfortable using computers.

As expected the study found a positive relationship between teacher Overall Attitude Towards Computers (OAC) and Attitude Towards Limited Use (ATL).

Effects of Teacher Attitude Towards Limited Use on UTJ and UTH

It is encouraging to know that teacher Attitude Towards Limited Use (ATL) has no affect on either Use of Technology at Work (UTJ) or at Home (UTH). Given the fact that only a minority of teachers (21.9%) felt that computers should be used only for certain students such as math and computer science majors, this does not come as a surprise.

Effect of Teacher Use of Technology at work on UTH

As expected, the results of the study support the fact that teacher Use of Technology on the Job (UTJ) affects the Use of Technology at Home (UTH). This means they are more likely to use a computer at home, provided one is available, if they are using one at work.

Conclusions and Implications for Future Research

The results of the present research study support the fact that technology integration into the K-12 curriculum is a complex matter and must be assailed through a number of variables. School district administrators, interested in integrating computers into their curriculum, need to provide resources for teachiers' training.

Teachers need to acquire good training and background since this affects (a) Overall Attitude Towards Use of Computers, (b) Use of Computers at Job and at Home, and (c) the formation of a Technology Integration Plan.

It is also assumed that adequate technology will be acquired through public and/or private funding. However, the state or the local district by itself may not have the resources to bring the technology integration plan into fruition. Formal agreements between businesses and education are becoming more and more common and are of necessity for funding of capital. Community resources and involvement may also be tapped. The answer to resource needs will be found in

the willingness of the private sector to intervene in areas that traditionally have been viewed as the domain of the public sector-areas. Obviously, if schools do not have equipment, they can do little to integrate technology into the learning process. "The reality is that the private sector needs a literate, skilled work force to be competitive in the world market-place" (Choquette, 1987, p. 4) and it should be at least willing to partially pay for it.

Upper management needs also to support the formation and implementation of a technology integration plan (since it affects teacher overall attitude toward use of computers). It needs to encourage teachers to use computers at work and to form a positive overall attitude towards the use of computers. If the teachers are negative toward information technology, the integration process will be difficult at best.

When a district considers and applies the findings of this study of the seven factors that discourage and/or encourage computer technology integration into its curriculum, and the priority relationships among the factors, schools will become more efficient and effective in preparing the future work force. As a result, all parties involved will be more satisfied with the learning process.

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APPENDIX

CANUTILLO INDEPENDENT SCHOOL DISTRICT INSTRUMENT

Upper Management Involvement

1. Campus administration encourages me to use computers for instructional purposes.

2. Campus administration encourages me to use computers for record keeping purposes.

Teachers' Training and Background

3. I have had formal training in computer use.

4. I feel comfortable using computers for my personal use.

5. I feel comfortable using computers in some aspect of my school tasks.

6. I would like to have more access to a computer at school for my instructional and record keeping needs.

Technology Integration Plan (TIP)

7. I am familiar with the Canutillo Independent School District (CISD) Technology Plan for integrating computers in curriculum.

8. I have been included in planning for technology at my campus.

Overall Attitudes Toward Computers (OAC)

9. I feel it is important for all students to use computers in school at every grade level.

10. Computers are appropriate for use by teachers to support instruction in all classes at every grade level.

11. If computers are used every student should have individual access to the computer.

12. Administrators should be computer literate and use one for administrative purposes.

13. Teachers should be computer literate and use one on a regular bases.

14. I feel it is important that I have access to electronic mail and telecommunications systems.

15. I feel it is important for teachers to develop computerized data bases to keep educational records.

Attitudes Toward Limited Use (ATL)

16. I feel it is important for certain students such as vocational, math, science, and/or gifted and talented, to use computers in school.

17. Computers are appropriate for use only by certain teachers at certain grade levels (i.e. high school advanced math and/or business teachers).

18. Computers are more suited for math and science than other subject areas.

Use of Technology on the Job (UTJ)

19. I use computers with students for instructional purposes (drill, tutorials, instructional word processing, programming, simulations, proofs, etc.).

20. I use computers for administrative purposes (gradebook, recordkeeping, test making, etc.).

21. I currently have access to a computer for instructional or administrative use at school.

Use of Technology at Home (UTH)

22. I am a self taught computer user.

23. I currently have a computer at home that I use for school purposes.

24. I currently have a computer at home which I do not use on a regular basis.

Table 1

Descriptive Statistics and Cronbach's Alpha Reliability Coefficients

Variable	Reliability	Mean	Standard Deviation
Upper Management Encouragement	.803	84.299	23.686
Training & Background	.682	69.055	17.539
Technology Integration Plan	.633	91.616	17.355
Overall Attitude Towards Computers	.876	41.986	16.952
Attitude Towards Limited Use of Computers	.701	61.890	27.446
Use of Technology at Job	.752	83.638	19.752
Use of Technology at Home	.580	85.671	17.209

Table 2

Factor Analysis Results of Technology Integration Instrument

Items	Factor Loadings						
	1	2	3	4	5	6	7
X1			0.759				
X2			0.704				
X3		0.797					
X4		0.496		0.506			
X5			0.710				
X6				0.838			
X7		0.835					
X8				0.802			
X9				0.412			
X10			0.433				
X17		0.757					0.434
X18		0.404					0.666
X19						0.818	
X20						0.780	
X21	0.807						
X22					0.860		
X23	0.792						
X24					0.872		
X25					0.511		
X26	0.627						
X27	0.755						
X28	0.826						
X29	0.669						
X30	0.731						

Table 3

Correlations and Beta and Gamma Coefficients for the Technology Integration Model

Correlation	Signifi. Level	Path From	Path To	Gamma and Beta Coefficient Variable	Gamma and Beta Coefficient Value	Gamma and Beta Coeff. Meaningful?	Gamma and Beta Coefficient Value > 0.05
.222	.004	UME	T&B	r(UME)(T&B)	0.222	YES	YES
.312	.001	UME	TIP	GAMMA(UME)(TIP)	0.279	YES	YES
.175	.024	UME	OAC	GAMMA(UME)(OAC)	0.091	YES	YES
.010	.901	UME	ATL	GAMMA(UME)(ATL)	-.039	NO	NO
.480	.000	UME	UTJ	GAMMA(UME)(UTJ)	0.407	YES	YES
.166	.034	UME	UTH	GAMMA(UME)(UTH)	0.013	YES	NO
.213	.006	T&B	TIP	BETA(T&B)(TIP)	0.151	YES	YES
.327	.000	T&B	OAC	BETA(T&B)(OAC)	0.294	YES	YES
-.087	.267	T&B	ATL	BETA(T&B)(ATL)	-.195	NO	YES
.415	.000	T&B	UTJ	BETA(T&B)(UTJ)	0.326	YES	YES
.237	.002	T&B	UTH	BETA(T&B)(UTH)	0.138	YES	YES
.154	.050	TIP	OAC	BETA(TIP)(OAC)	0.063	YES	YES
.135	.084	TIP	ATL	BETA(TIP)(ATL)	0.150	YES	YES
.201	.010	TIP	UTJ	BETA(TIP)(UTJ)	0.003	YES	NO
.023	.768	TIP	UTH	BETA(TIP)(UTH)	-.071	NO	YES
.210	.007	OAC	ATL	BETA(OAC)(ATL)	0.257	YES	YES
.181	.021	OAC	UTJ	BETA(OAC)(UTJ)	-.002	NO	NO
.047	.549	OAC	UTH	BETA(OAC)(UTH)	-.055	NO	YES
-.008	.916	ATL	UTJ	BETA(ATL)(UTH)	0.016	YES	NO
.002	.978	ATL	UTH	BETA(ATL)(UTH)	0.038	YES	NO
.359	.000	UTJ	UTH	BETA(UTJ)(UTH)	0.320	YES	YES

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Table 4

Beta and Gamma Coefficients for the Trimmed Technology Integration Model

Path From	To	Gamma and Beta Coefficient Variable	Gamma and Beta Coefficient Value	Gamma and Beta Coeff. Value > 0.05
UME	T&B	r(UME)(T$B)	0.222	YES
UME	TIP	GAMMA(UME)(TIP)	0.279	YES
UME	OAC	GAMMA(UME)(OAC)	0.091	YES
UME	UTJ	GAMMA(UME)(UTJ)	0.408	YES
T&B	TIP	BETA(T&B)(TIP)	0.151	YES
T&B	OAC	BETA(T&B)(OAC)	0.294	YES
T&B	UTJ	BETA(T&B)(UTJ)	0.324	YES
T&B	UTH	BETA(T&B)(UTH)	0.106	YES
TIP	OAC	BETA(TIP)(OAC)	0.063	YES
TIP	ATL	BETA(TIP)(ATL)	0.106	YES
OAC	ATL	BETA(OAC)(ATL)	0.193	YES
UTJ	UTH	BETA(UTJ)(UTH)	0.315	YES

Table 5

Original and Reproduced Correlations for the Technology Integration Model

Path From	To	Original Correlation (OC)	Reproduced Correlation (RC)	Residual (OC-RC)	Normalized Residual (N R)	Path From	To	NR > 2.00
UME	T&B	0.222	0.222	0.000	0.000	UME	T&B	NO
UME	TIP	0.312	0.312	0.000	0.000	UME	TIP	NO
UME	OAC	0.176	0.176	0.000	0.000	UME	OAC	NO
UME	ATL	0.010	0.067	-.057	-.728	UME	ATL	NO
UME	UTJ	0.480	0.480	0.000	0.000	UME	UTJ	NO
UME	UTH	0.166	0.175	-.009	-.111	UME	UTH	NO
T&B	TIP	0.213	0.213	0.000	0.000	T&B	TIP	NO
T&B	OAC	0.328	0.328	0.000	0.000	T&B	OAC	NO
T&B	ATL	-.087	0.086	-.173	-2.202	T&B	ATL	YES
T&B	UTJ	0.415	0.415	0.000	0.000	T&B	UTJ	NO
T&B	UTH	0.237	0.237	0.000	0.000	T&B	UTH	NO
TIP	OAC	0.154	0.154	0.000	0.000	TIP	OAC	NO
TIP	ATL	0.135	0.135	0.000	0.000	TIP	ATL	NO
TIP	UTJ	0.201	0.196	0.005	0.060	TIP	UTJ	NO
TIP	UTH	0.023	0.084	-.061	-.781	TIP	UTH	NO
OAC	ATL	0.210	0.210	0.000	0.000	OAC	ATL	NO
OAC	UTJ	0.181	0.178	0.003	0.032	OAC	UTJ	NO
OAC	UTH	0.047	0.051	-.004	-.557	OAC	UTH	NO
ATL	UTJ	-.008	0.056	-.064	-.810	ATL	UTJ	NO
ATL	UTH	0.002	0.026	-.024	-.312	ATL	UTH	NO
UTJ	UTH	0.359	0.359	0.000	0.000	UTJ	UTH	NO

Figure 1. Technology integration causal model

UME = Upper management encouragement
T&B = Training and background
TIP = Technology Integration Plan
OAC = Overall attitudes
ATL = Attitudes toward limited use
UTJ = Use of technology on job
UTH = Use of technology at home

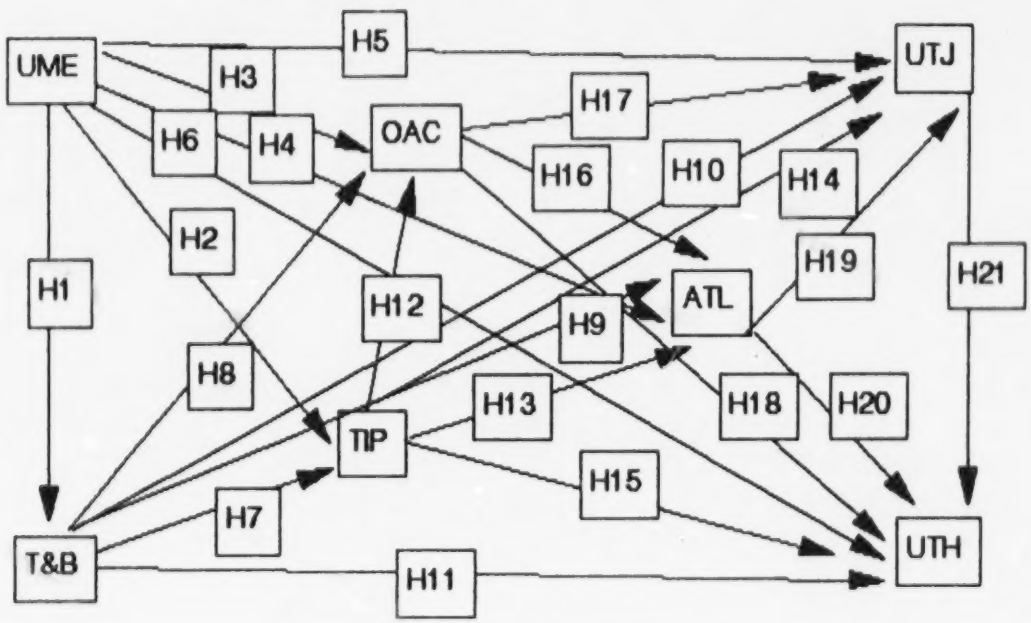

Figure 2. Trimmed technology integration causal model

UME = Upper management encouragement
T&B = Training and background
TIP = Technology Integration Plan
OAC = Overall attitudes
ATL = Attitudes toward limited use
UTJ = Use of technology on job
UTH = Use of technology at home